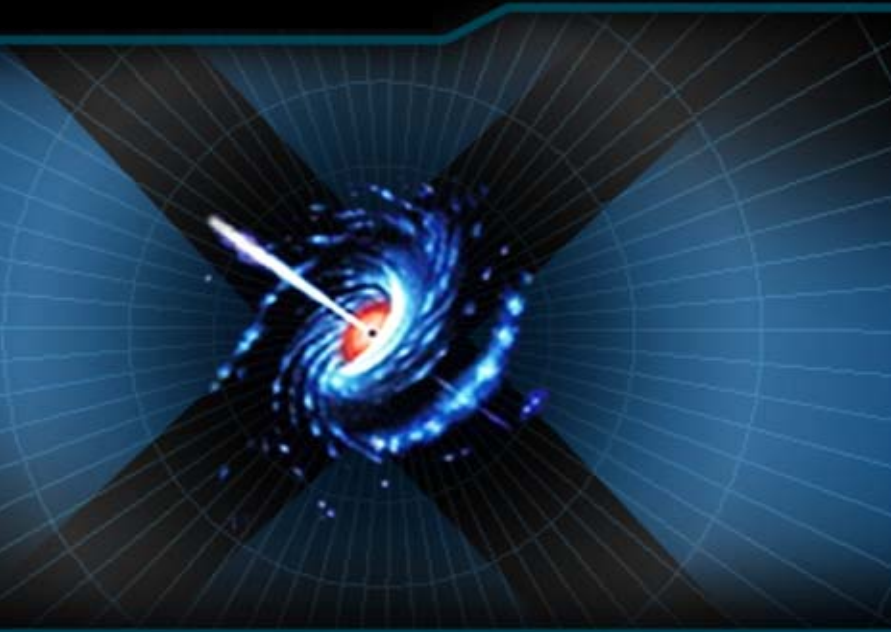


# Constellation

The Constellation X-ray Mission



## ►► Straylight Considerations for Formation Flying

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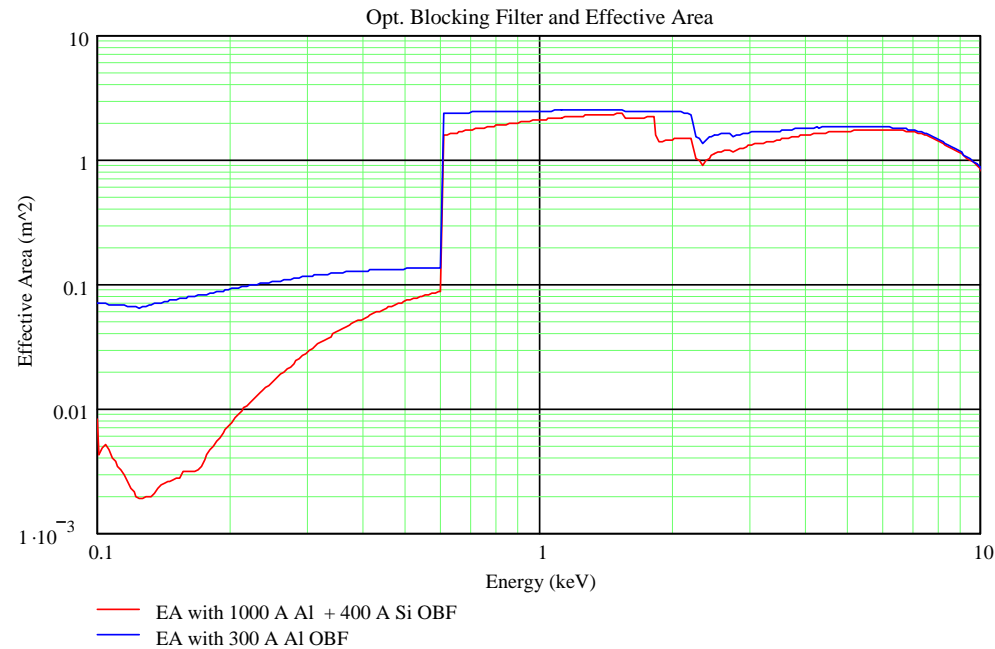
## Introduction and Requirements

- Formation flying places new requirements on straylight baffling since we have “discarded” the shielding tube that typically encloses telescope
- Requirements flowed down from Top Level Requirements
  - measure faint object spectra to limit of  $2 \times 10^{-15}$  ergs-cm<sup>-2</sup>-s<sup>-1</sup> (0.2-2keV)
  - spectral bandpass of 0.25 to 40 keV
  - resolution requirement of  $R \geq 300$  over 0.25 to 10 keV
  - effective area  $\geq 0.1$  m<sup>2</sup> over 0.25 to 10 keV (except where otherwise specified at larger values)
- Consider stray visible light from Sun and diffuse x-ray background (DXB).
  - subsequent activity will consider straylight from Earth, Moon, bright planets, and zodiacal light

## Flowed-down Requirements

- **Visible straylight**
  - RGS/RFC is the most constrained case due to low E bandpass
  - allow  $\sim 2$  vis photons/pixel/integration period
    - limits straylight to level comparable to CCD readout noise
  
- **Diffuse X-ray Background**
  - again, RGS/RFC is the most constrained case
  - limit DXB to comparable to or less than other limiting noise sources
    - CCD readout noise
    - cosmic ray background
  - allow  $\sim 1 \times 10^{-6}$  counts-s<sup>-1</sup>-sq arcsec<sup>-1</sup>
    - ACIS-I rate

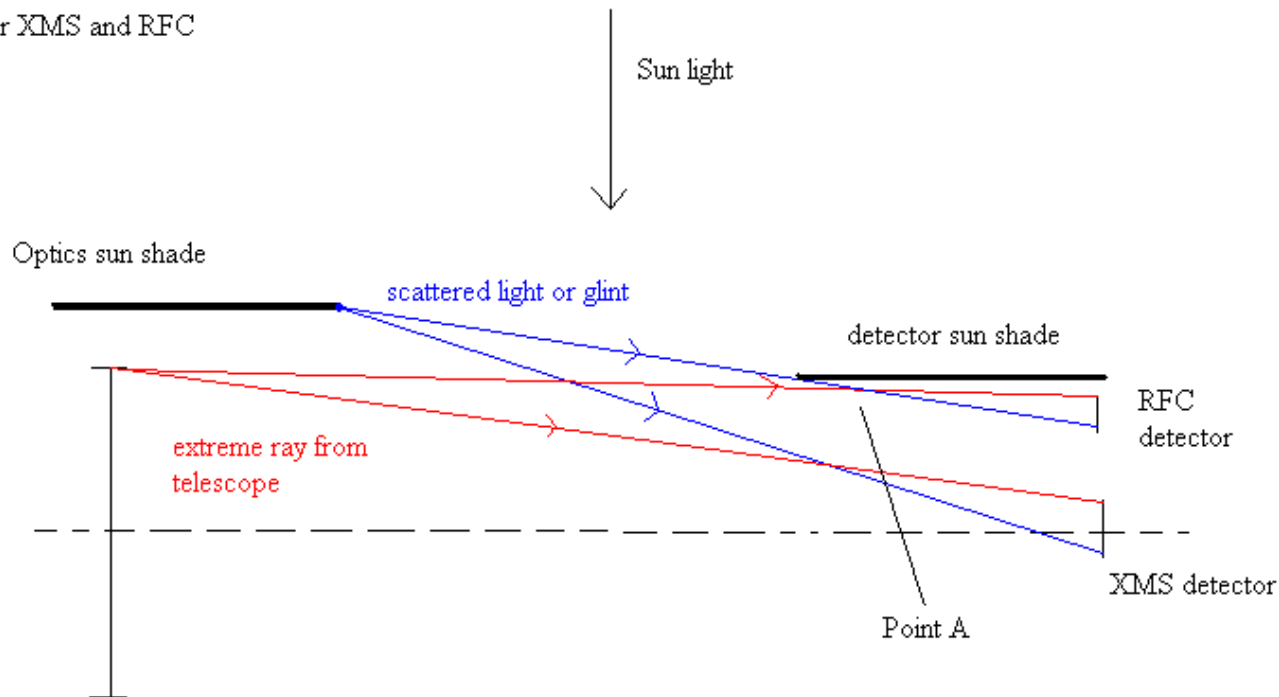
## Baffling vs. optical blocking filters: preliminary analysis



- preliminary analysis with 4 m diameter telescope configuration
- if only shield against direct illumination, stray light requirement coupled with solar flux and estimated baffle size requires minimum OBF thickness of ~ 1000 Å Al + 400 Å Si
- if shield against scattered illumination, minimum OBF thickness ~ 300 Å Al
- Thicker blocking filters are inconsistent with low E Effective Area Req't

## Design considerations - I

for XMS and RFC



Notes: Point A is the intersection of the extreme rays from the optics and the scattered light from the optics s/c sun shade. To shield the detector, the detector sun shade must be long enough to reach point A (or further), and be large enough to not block the telescope extreme ray. The intersection point is easy to find by establishing the equations for the lines that form the two rays shown (i.e., block the "blue" ray while not blocking the "red" ray). If the RFC is on the anti-sun side of the XMS, the detector sun shade must be even longer

## Design considerations - II: Shade lengths

Case	Optics Shade Y Position (m)	Shade Length (m)
Sun side	2.3	15.7
	4	6.9
90 deg from Sun side	2.3	11.6
	4	5.6
Anti-sun side	2.3	9.8
	4	5.3

- The further the straylight baffles are radially out from the optical axis, the shorter they can be axially.
- Shade size can be quite large - “half a tennis court”

## “Engineering” Requirements

- No direct view of sky and/or sun by detectors
- No direct illumination of mirrors - forward or aft ends - by sun
- No direct illumination of grating assy - forward or aft ends - by sun
- No direct view of by RGA of sky
- No singly scattered/reflected sunlight allowed to enter detectors
  - I.e., cannot scatter off of aft end of mirror sunshade into detectors
  - need to examine whether can tolerate scatter off aft end of mirror sunshade into forward end of grating assy - believe not allowed
- Requirements apply over full range of pitch ( $\pm 30$  deg), roll ( $\pm 15$  deg), and yaw ( $\pm 180$  deg)
- Note: still need to examine impact of Earth/Moon/bright planets/Zodiacal light

## Summary

- Formation flying imposes different straylight constraints upon mission
- Large straylight shields/baffles will be required
- Large shields may complicate mission configuration and formation flying requirements